4 Regulatory Activities

Building Technologies Regulatory Activities, including Appliance and Equipment Standards and Building Energy Codes, address our continuing legislative requirements to improve the minimum efficiency for buildings by implementing energy efficiency codes, standards, and guidelines for building equipment, appliances, and federally owned buildings.

The building energy codes must be technologically feasible and cost effective on a life-cycle basis. By eliminating the most inefficient technologies and building practices, we complement the other strategies which develop and promote advanced, highly efficient technologies and practices. National standards also provide manufacturers with a single set of requirements rather than an array of potentially conflicting State and local regulations.

4.1 Appliance and Equipment Standards

Congress passed laws setting initial federal energy efficiency standards and establishing schedules for DOE to review and revise these standards. For some products, Congress has directed DOE to set standards in the absence of initial standards or to determine if such action is necessary. Standards benefit consumers by requiring that appliance manufacturers reduce the energy and water use of their products—and thus the costs to operate them. DOE's subprogram carries out activities in three areas: labeling, test procedures, and mandatory energy conservation standards.

- Labeling: The Federal Trade Commission (FTC) is required to prescribe labeling rules for residential appliances. DOE and FTC share responsibility for labeling commercial equipment.
- Test Procedures: DOE outlines the test procedures that manufacturers must use to certify that their appliances meet the standards. The test procedures measure the energy efficiency and energy use and provide an estimate of the annual operating cost of each appliance. Test procedures are typically maintained by industry associations and incorporated by reference into the rules set by DOE.
- Mandatory Energy Conservation Standards: DOE establishes federal standards to keep consistent, national energy efficiency requirements for selected appliances and equipment. By law, DOE must upgrade standards to the maximum level of energy efficiency that is technically feasible and economically justified. DOE strives to establish standards that maximize consumer benefits and minimize negative impacts on manufacturers and others.

Recent requirements associated with section 141 of the Energy Policy Act of 2005 (EPACT 2005), Pub. L. 109-58, which pertains to the Department of Energy's (DOE or Department) failure to comply with deadlines for new or amended energy conservation standards, led to the Department in outlining its approach to Appliance Standards to Congress. The report covers the multi-year plan associated with Appliance Standards, as well as provides background on the program. Specifically, it:

- Presents a history of the Appliance Standards Program and the Process Rule adopted in 1996 that gives the reader a full understanding of the historical context and statutory requirements for the program.
- Summarizes all rulemaking activities and requirements under existing statutes, including EPACT 2005.
- Provides a detailed description of the Department's rulemaking processes and the statutory requirements for conducting rulemakings.
- Describes the reasons for the delays in completing rulemakings, including the unintended consequences of the Process Rule that introduced delays into rulemaking activities.
- Presents the Department's plan for addressing the problems and issues identified, and explains several productivity enhancements that will be used to significantly increase the production of energy conservation standards.

- Presents and explains the multi-year schedule the Department will follow as it addresses the backlog and implements the requirements of EPACT 2005.

The entire report can be downloaded at:
http://www.eere.energy.gov/buildings/appliance_standards/pdfs/congressional_report_013106.pdf

4.2 Building Energy Codes

Building energy codes define the minimum requirements for new construction, including additions and alterations to existing buildings. Building energy codes set minimum requirements for building thermal envelope performance, building mechanical system performance[1], and building lighting and power system performance (commercial buildings only). Commercial building energy codes also set building mechanical equipment requirements that are the starting point for DOE's equipment standards rulemakings.

4.2.1 Building Energy Codes Overview

Building energy codes do not address all of the energy usage in residential or commercial buildings. Table 4-1 shows residential and commercial energy use subject to building energy codes requirements. Note that building end uses are the sum of energy used by appliances, equipment, and systems used to serve a particular building load. While building energy codes do not typically cover appliances or equipment, building energy codes do cover systems and the building thermal envelope, which are significant drivers in both space heating and space cooling.

Table 4-1 Residential and Commercial Energy Usage Subject to Building Energy Codes

Sector	Residential[1]	Commercial[2]
End-Use		
Space Heating	Covered	Covered
Water Heating	Covered	Covered
Space Cooling	Covered	Covered
Lighting	Not Covered	Covered
Ventilation	Not Considered[3]	Covered
Refrigeration	Not Covered	Not covered
Wet Clean[4]	Not Covered	Not Considered[5]
Electronics	Not Covered	Not covered
Cooking	Not Covered	Not covered
Computers	Not Covered	Not covered
Other	Partially Covered[6]	Not covered

[1]Residential end-use taken from 2004 BED Table 1.2.3
[2]Commercial end-uses taken from 2004 BED Table 1.3.3
[3]End-use not broken out in residential table
[4]Clothes washing/drying and dishwashing
[5]End-use not listed in commercial table. This would be considered industrial usage.
[6]Pool and hot tub heaters and motors are covered in some building energy codes

Note that the above table does not imply that end uses that are not covered by building energy codes are not regulated by any standards. The residential refrigeration and wet clean (laundry and dishwashing) end uses are addressed by DOE's appliance standards

[1] The efficiency of many classes of HVAC equipment, especially equipment generally used in residences, is preemptively regulated by manufacturing standards resulting from the National Appliance Energy Conservation Act of 1987 (NAECA) and is therefore outside the scope of building energy codes.

project. Nor does the fact that an end use is covered by building energy codes indicate that DOE's Building Energy Codes subprogram is solely responsible for that end use. For example, space heating, water heating, and space cooling responsibility are shared between building energy codes (which address the building envelope and mechanical systems) and `appliance standards (which address the mechanical equipment).

Table 4-2 is derived from the same tables in the 2004 BED to show what portion of building energy usage is impacted by building energy codes. For each end use that is listed as covered in Table 4-1, the estimated site and primary energy impacts are listed.

Table 4-2 Residential and Commercial Energy Usage Subject to Building Energy Codes

Sector	Residential Quads[1]		Commercial Quads[2]	
End-Use	**Site**	**Primary**	**Site**	**Primary**
Space Heating	5.56	6.62	1.99	2.46
Water Heating	1.75	2.66	0.82	1.13
Space Cooling	0.80	2.59	0.64	2.04
Lighting	Not covered	Not covered	1.36	4.37
Ventilation	Not split out	Not split out	0.31	1.01
Refrigeration	Not covered	Not covered	Not covered	Not covered
Wet Clean	Not covered	Not covered	Not covered	Not covered
Electronics	Not covered	Not covered	Not covered	Not covered
Cooking	Not covered	Not covered	Not covered	Not covered
Computers	Not covered	Not covered	Not covered	Not covered
Other	Assumed zero	Assumed zero	Not covered	Not covered
Adjustment to SEDS	Not covered	Not covered	Not covered	Not covered
Total Covered	8.11	11.87	5.12	11.01
Total Sector	11.30	20.91	8.28	17.43
Percent Covered	72%	57%	62%	64%

[1]Residential end-use taken from 2004 BED Table 1.2.3
[2]Commercial end-uses taken from 2004 BED Table 1.3.3

While the table aboveTable 4-2 indicates that a considerable fraction of both residential and commercial sector energy use is subject to building energy codes, it bears repeating that this coverage is shared with appliance standards, and also that this coverage is for new construction in new and existing buildings. Separating the impact of building energy codes from appliance standards is not easy, and no attempt to do so is made here.

Estimating the impact of the new construction only aspect of building energy codes is somewhat easier. New construction represents a fraction of the total buildings sector, as shown in Table 4-3.

Table 4-3 Annual New Construction as a Fraction of Total Building Sector

New Construction	Residential	Commercial
Long-Term Construction Rate	1.5 to 2 million units per year[1]	1.3 billion square feet[2]
Long-Term Sector Total	83 million units[3]	72.1 billion square feet[4]
Fraction of New Construction	Up to 2.5%	1.8%

[1]Range of new homes completed annually from 1980 to 2003, including multi-family and mobile homes, as shown in 2004 BED Table 2.1.6
[2]Average predicted annual increase in square footage from the 2004 BED Table 2.2.1 for years 2002 to 2025
[3]2000 estimated number of residential buildings from 2004 BED Table 2.1.1
[4]2002 estimated square footage of commercial buildings from 2004 BED Table 2.2.1

While Table 4-3 indicates that the turnover rate for both the residential and commercial sectors is approximately equal (at about 2 percent per year), it should be noted that the commercial sector statistics are based on net increases in floor space, rather than actual new construction, and are therefore probably low because of commercial demolition. According to Tables 2.1.1 and 2.2.1 of the 2004 BED, 3 percent of the residential housing stock (units) and 9 percent of commercial building stock by floorspace was "post-2000" in 2002. This statistic indicates that the turnover of commercial building stock is considerably faster than in the residential sector, which in turn indicates that building energy codes (and appliance standards) may be more significant agents of change in the commercial sector than in the residential sector.

The emphasis on new construction in building energy codes, be it in new buildings or additions or alterations in existing buildings, is related to enforcement of and/or compliance with these building energy codes. Building energy codes must be used to design buildings if they are to have any impact. The two methods by which building energy codes are commonly used are:

1. The code or standard is adopted via regulatory or legislative procedure by a state or local jurisdiction; and
2. The code or standard is considered a professional standard of care in the design industry.

4.2.2 Building Energy Codes Federal Role and History

The life cycle of the Building Energy Codes subprogram is established by legislation and the 3-year cycle for upgrading the model building energy building energy codes.[2] Title

[2] Building Energy Codes describe two sets of documents that contain instructions and requirements for constructing energy-efficient buildings. The term "code" points to documents that are typically adopted into law at the Federal, state, or local level, while the term "standard" typically indicates a document developed under the auspices of the American National Standards Institute (ANSI) by a professional or trade organization (such as ASHRAE). However, some standards are now intended to be adopted into law and are therefore written to appear "code-like." The distinction is primarily historical at this point in time.

III of the Energy Conservation and Production Act, as amended (ECPA) (42 USC 6831 et seq.), requires the Department of Energy to:

1. Support the upgrading of model building energy codes (American Society of Heating Refrigerating and Air-Conditioning Engineers' (ASHRAE) Standard 90.1, for commercial buildings, and the International Code Council's (ICC) International Energy Conservation Code (IECC), for residential buildings). Review and assist in improving the technical basis, determining cost effectiveness, and technical feasibility of code measures and, based on ongoing research activities, recommend and seek adoption of feasible, cost effective measures.

2. Review and upgrade the Federal building energy codes (10 CFR 434 and 435) with technically feasible, cost-effective code measures. DOE maintains Federal building energy codes as distinct from the voluntary sector building energy codes to reflect the unique financial perspective of the Federal sector and to address the role of the Federal sector in leading the private sector towards greater energy efficiency. 10 CFR 434 is the current Federal commercial standard and 10 CFR 435 (subpart C) is the current Federal residential standard.

3. Publish a determination in the *Federal Register* as to whether each new edition of the model codes will improve the energy efficiency of buildings.

4. Provide incentive funding and technical assistance to states to update, implement and enforce their code to meet or exceed the upgraded model codes that the Department of Energy has determined will improve the energy efficiency of buildings.

The model code organizations have established a 3-year upgrade cycle, receiving and deliberating on proposed amendments to the model codes and republishing a new edition of each model code every 3 years. Accordingly, the Building Energy Codes subprogram participates in the 3-year code cycle process to upgrade the model energy codes, based on advances in research, demonstration, incentive, and design and construction practices. DOE then publishes determinations regarding the new model code editions, within the 1-year legislated time frame of each code's publication. Positive determinations (those that find substantial efficiency improvement in a new code edition) in turn trigger state activities, mandated by the legislation, to certify to DOE that a state has updated its commercial code(s) and determined whether or not it is appropriate to update its residential codes.

In parallel with the determinations, technical assistance tools and materials are upgraded after changes in the model codes. In concert with the upgrading of the model codes, the Building Energy Codes subprogram reviews and upgrades the Federal codes, within the legislated 5-year review requirement. This cycle is repeated with the initiation of the next 3-year model code cycle. In recent years, the Building Energy Codes subprogram

within BT has also been actively participating in both above code and beyond code[3] programs that consider building requirements beyond the minimum requirements of codes (such as Building America for residential buildings and ASHRAE's Advanced Energy Design Guide for commercial buildings) to utilize the ideas and concepts from those efforts as the precursors for the building energy codes of the future.

The Building Energy Codes subprogram has moved through this lifecycle several times since the legislation was last revised in 1992.

1. DOE participated in the upgrading of Standard 90.1 in 1999, 2001, and 2004, improving all aspects of the standard including usability, enforceability, and stringency. This has resulted in source energy savings of approximately 11 percent over ASHRAE Standard 90.1-1989 for new commercial buildings[4].
2. Participated in the upgrading of the Model Energy Code (MEC) (the predecessor of the IECC) in 1993 and 1995, and the IECC in 1998, 2000, 2003, and 2006 (in progress at the time of writing). DOE was largely responsible for the complete rewrite and simplification of the residential requirements now included in the 2004 Supplement to the IECC. These have resulted in 5 percent savings over the 1992 MEC for new homes.
3. Published determinations regarding Standard 90.1 for commercial buildings in July 2002 (for the 1999 version of Standard 90.1).
4. Published determinations regarding the IECC for residential buildings in January 2001 (for the 1998 and 2000 IECC).
5. Upgraded 10 CFR 434 in 1998, which has resulted in 5 percent savings over the earlier Federal commercial standard.
6. Proposed an upgrade to 10 CFR 434 in 2005 that would save an additional 18% over the previous Federal commercial standard.
7. Proposed an upgrade to 10 CFR 435 for Federal residential buildings in 1997.
8. Developed the Check building energy code compliance software suite, including MECcheck (now REScheck), and COMcheck-EZ. The Check software currently serves residential codes from 1992 to the present and commercial codes from 1989 to the present. (This effort is currently funded by WIP, but managed by BT.)

BT's Building Energy Codes subprogram has just finished supporting the upgrade of Standard 90.1-2001, which was published in December 2004 as ASHRAE Standard 90.1-2004. This is expected to meet the objective described above, and will initiate

[3] "Above code" programs consider higher efficiency levels of the same requirements typically found in codes. "Beyond code" programs may consider both higher efficiency levels of code requirements and/or entirely different types of requirements. "Green building" programs are typically beyond code because they deal with issues that are entirely outside the scope of codes.

[4] Savings estimates derived from energy from DOE's Standard 90.1-1999 formal determination of energy savings available online at http://www.energycodes.gov/implement/determinations_com_exp.stm (3.9% site and 5.9% source) and an unpublished estimate of the energy savings for Standard 90.1-2004 based on a 25.9% reduction in lighting power allowance coupled with an assumption of 16% site/24.7% of commercial building energy usage associated with lighting based on the BED, which adds another 4% site, 6% source savings.

development of a determination regarding this upgrade to Standard 90.1. In 2007, this cycle will start over again, culminating in the publication of the 2010 edition of Standard 90.1.

The subprogram is also currently supporting the upgrade of the 2003 IECC for both residential and commercial buildings, which will be published in 2006. This is expected to meet the objective described above, and will initiate development of a determination regarding this upgrade to the IECC. In 2006, this cycle will start over again, culminating in the publication of the 2009 edition of IECC.

4.2.3 Building Energy Codes Strategic Goals

The strategic goals of the Building Energy Codes subprogram are to:

(1) Drive the development of voluntary sector building energy building energy codes to achieve energy savings in new residential and commercial construction of approximately 3 percent to 6 percent every 3 years during the 2005 to 2025 period.

(2) Continually update the Federal sector building energy codes to achieve energy savings in new Federal construction of approximately 30 percent beyond corresponding voluntary sector building energy codes during the 2005 to 2025 period.

4.2.4 Building Energy Codes Performance Goals

The milestones of the Building Energy Codes subprogram are listed below for the residential, commercial, and Federal sectors. The use of milestones instead of targets is indicative of the fact that the Building Energy Codes subprogram participates in code and standard development processes that are owned and controlled by other organizations. The building energy codes listed here will be published on the dates mentioned with or without DOE participation. DOE's role is to support the development of these building energy codes and achieve the desired energy savings outcomes described below. The only targets associated with building energy codes are the Joule metrics associated with the subprogram. These are discussed following the list of milestones.

Residential Sector

- By 2007, have supported the upgrading of the *2006 International Energy Conservation Code* (IECC) to include improved envelope and mechanical requirements for residential buildings.
- By 2008, have published in the *Federal Register* a determination that the *2006 International Energy Conservation Code* will increase the energy efficiency of residential buildings, initiating a requirement that the states and territories certify by 2009 to the DOE that they have determined whether they should update their residential codes to meet or exceed the 2006 edition of the IECC.
- By 2008, have upgraded the technical assistance core tools and materials to assist states to upgrade their codes to the 2006 IECC.

- By 2010, have supported the upgrade of the *2009 International Energy Conservation Code* to include improved envelope and mechanical requirements for residential buildings.

Commercial Sector

- By 2006, have supported the development of an additional 30% above code design guidance from the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), Illuminating Engineering Society of North America (IESNA), and American Institute of Architects (AIA) for retail buildings
- By 2006, have published in the *Federal Register* a determination that *ANSI/ASHRAE/IESNA Standard 90.1-2004* will increase the energy efficiency of commercial buildings, initiating a requirement that the states and territories certify by 2008 to the DOE that they have determined whether they should update their residential codes to meet or exceed the 2004 edition of ASHRAE Standard 90.1.
- By 2007, have supported the development of an additional 30% above code design guide from ASHRAE, IESNA, and AIA for another building type.
- By 2007, have supported the upgrading of the *2006 International Energy Conservation Code* to include improved lighting, envelope and mechanical requirements for commercial buildings.
- By 2008, have supported the upgrading of Standard 90.1-2007, *Energy Efficient Design of Buildings Except Low Rise Residential Buildings,* to include:
  - Additional lighting control requirements, including occupancy sensors;
  - Improved building envelope requirements because of integrated design considerations;
  - Cool roof requirements; and
  - Improved mechanical system requirements related to demand control ventilation, energy recovery, and variable-speed drive pumps.
- By 2008, have upgraded the technical assistance core tools and materials to assist states to upgrade their codes to Standard 90.1-2006.
- By 2010, have supported the upgrading of the *2009 International Energy Conservation Code* to include improved lighting, envelope and mechanical requirements for commercial buildings.
- By 2011, have supported the upgrading of Standard 90.1-2010, *Energy Efficient Design of Buildings Except Low Rise Residential Buildings,* to include:
  - Continuous air barrier and other envelope infiltration requirement
  - Advanced lighting controls (including daylighting)
  - Improved mechanical system control and selection.

Federal Sector

- By 2007, propose an upgraded Federal commercial building energy code to meet or exceed Standard 90.1-2004.
- By 2007, finalize an upgraded Federal residential building energy code that improves the energy efficiency of new Federal sector buildings built to code to the level of Energy Star homes (approximately 30% over the 2006 IECC).

- By 2008, issue an upgraded Federal commercial building energy code that will use at least 12% less energy than buildings built to 10 CFR 434 (1989).
- By 2010, propose an upgraded Federal commercial building energy code to meet or exceed Standard 90.1-2008.

BT's targets in building energy codes are to improve the stringency of various sector codes by specified amounts per year. For both the residential and commercial sectors, the BT joule metric is "analyze and develop code change proposals that are expected to result in a cost-effective improvement in energy efficiency in residential/commercial buildings of approximately 1% to 2% per year." Because both the ICC and ASHRAE building energy codes are on 3-year development cycles, the concept of an annual improvement in the codes is not really applicable. However, multiplying the annual goal by a factor of three to get a code development cycle goal is appropriate. Targets for various sectors are shown in Table 4-4.

Table 4-4 BT Improvement Goals for Building Energy Codes[5]

Sector	Goal
Voluntary Residential	3% to 6% per code change cycle relative to previous code
Federal Residential	Equivalent to Energy Star
Voluntary Commercial	3% to 6% per code change cycle relative to previous code
Federal Commercial	Voluntary sector code plus all cost-effective measures (based on Federal sector economics) (targeted at 30% above voluntary sector)

BT's building energy codes efforts are not focused on high performance buildings (as many other BT programs are) but rather on a slow, but inevitable improvement in the baseline practice of new construction by establishing ever-increasing minimum performance standards. A rate of 1% to 2% per year, compounded over time, can provide significant energy savings in new construction and can significantly transform marketplace dynamics to lower resistance to new and innovative products and construction practices. Table 4-5 shows the resulting levels of efficiency that will be achieved in codes if the building energy codes goals are achieved.

[5] Expressed in code change cycles rather than annual metrics.

Table 4-5 Potential Increase in Code Stringency at 1% to 2% Improvement per Year[6]

Year	1% Per Year Improvement	2% Per Year Improvement
2004 (Baseline)	1.00	1.00
2005	0.99	0.98
2006	0.98	0.96
2007	0.97	0.94
2008	0.96	0.92
2009	0.95	0.90
2010	0.94	0.89
…	…	…
2025	0.81	0.65

Table 4-5 indicates the power of codes to influence building energy usage over a long period of time. BT's building energy codes efforts should result in stringency increases of 6% to 11% in new construction by the year 2010, with the potential to achieve 19% to 35% savings if these efforts are carried out until 2025. An increasing majority of the two million new homes and millions of new commercial square footage per year eventually falls under new more stringent energy codes and the savings add up.

However, the ability of codes to influence building energy usage depends on the ability of codes to continuously improve. In the codes world, code improvement is typically tied to cost-effectiveness. Improvement in codes tends to occur in one of three ways:

1. The costs of new technologies are reduced sufficiently that they can be considered for inclusion as mandates in codes;
2. Code developers become more clever in how they determine cost-effectiveness; or
3. Economic parameters change enough to make existing technologies appear more attractive.

DOE's Building Energy Codes subprogram seeks to identify new cost-effective technologies or new ways to determine cost-effectiveness in their efforts to improve codes. For example, work is going on now to determine if a cost credit for downsizing HVAC equipment as a result of improved building envelopes could be used to help cost-justify those improved envelopes. This is a simple application of integrated design principles commonly used in individual building designs, but applying that same principle to the generic building designs considered in building energy codes is challenging.

Historical evaluations of commercial building energy codes improvement indicate that this goal of 1%-2% per year is achievable, although the improvements do tend to come in larger chunks. For example, energy savings in ASHRAE Standard 90.1 from 1989 to

[6] Expressed as energy consumption relative to a 2004 baseline.

1999 were estimated at about 4% site and 6% source[7] . Savings in Standard 90.1 from 1999 to 2001 were negligible, but savings from 2001 to 2004 are estimated to be at least 4% site and 6% source.

Because BT's building energy codes targets are expressed as annual (or code cycle) increases in code stringency, these are targets that can be measured and tracked by simply evaluating the applicable code or standard using the same energy saving analysis used in the preparation of DOE's formal determinations of energy savings. This will require perhaps more frequent analysis of the energy savings of building energy codes than has occurred previously, and it will certainly require that analysis efforts in the voluntary commercial sector expand to include both ASHRAE Standard 90.1 and the ICC IECC, but the process is comparing old and new versions of a code or standard is usually straightforward.[8]

4.2.5 Building Energy Codes Market Challenges and Barriers

The primary risks and barriers in both DOE's larger codes efforts and in BT's specific building energy codes efforts tend to be more political or economic than technical. The basic premise in the development of all building energy codes is that whatever is required by the code or standard should be so obviously beneficial to the building or building owner or building occupants that there is little opposition to the requirement (except, possibly, for entrenched special interests). This is the basis for the consensus processes that various code-writing organizations tend to follow. Thus, the BT Building Energy Codes subprogram faces none of the technical risk associated with the development of new building technologies or new construction techniques. If those new technologies or techniques are developed and shown to be cost-effective, then they may eventually be incorporated into building energy codes. But as a general rule, building energy codes are developed to be technology neutral by the code development organizations such as ASHRAE and ICC. Neither of these organizations is interested in "pushing" specific technologies for fear of stifling innovation and in their own self- interest as they try to avoid being accused of favoritism or market manipulation by competitors in the marketplace. Because BT is only one of many players in the processes controlled by ASHRAE and ICC, BT is essentially constrained to remain technology-neutral as well.

The single largest barrier faced by the BT Building Energy Codes subprogram is opposition to regulation and especially opposition to increased stringency of regulation on a particular component, system, or building.

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[7] *Commercial Buildings Determinations: Explanation of the Analysis and Spreadsheet,* U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Last revised April 1, 2004.

[8] The exceptions are new codes that have significant changes in format and/or scope or that contain a mixture of efficiency improvements and degradations.

Table 4-6 Building Energy Codes Market Challenges and Barriers

Barrier	Title	Description
A	Opposition to regulation	The single largest barrier faced by the BT Building Energy Codes subprogram is opposition to regulation and especially opposition to increased stringency of regulation on a particular component, system, or building.

This opposition is commonly expressed in terms of economics, but opposition also takes the form of detailed questioning of assumptions, baseline conditions, methodologies, etc. The bottom line is that it makes sense to many participants in the buildings community to oppose at least some aspects of building energy building energy codes and so opposition is spirited. The role of the BT Building Energy Codes subprogram in all this is to provide thorough, balanced, and well-documented analysis that will lead to the incorporation of cost-effective improvements to energy building energy codes. This is really where the bulk of the effort in this subprogram takes place.

4.2.6 Building Energy Codes Technical (Non-Market) Challenges and Barriers

Technically, the largest barriers that BT's Building Energy Codes subprogram faces are associated with the following.

Table 4-7 Building Energy Codes Technical Challenges/Barriers

Barrier	Title	Description
B	Lack of hard data	Lack of hard data on current construction practice (primarily a commercial issue). This lack makes it hard to determine if codes are too stringent or not stringent enough.
C	Lack of detailed construction cost data	Lack of detailed construction cost data (worse for commercial than residential, but an issue for both, especially for "non-standard" constructions). This lack of data makes it hard to develop cost justification for new requirements in building energy codes.
D	Lack of current code compliance data	Lack of current code compliance data (an issue for both the WIP and BT funded subprograms of DOE's efforts). This lack makes it hard to identify code requirements that might be too complex or simply unworkable (a BT issue) or areas of the code where additional training might be necessary (a WIP issue).

The intended use of this data is primarily to counteract arguments that proposed code changes are too expensive, too stringent, or unworkable, but also to help identify new areas for code change proposals. With the continued scaling back of DOE's Commercial Buildings Energy Consumption Survey (CBECS) and the ending of commercial building permit data collection in the mid-1990s, data on growth of the commercial building sector on a state-by-state basis and knowledge of what those buildings look like has been

increasingly hard to gather. All of this type of data is necessary in efforts to demonstrate that proposed changes to codes are both cost-effective and enforceable nationally and in states that might consider adopting the codes. BT has made some efforts to collect current construction practice data (via the New Commercial Construction Characteristics (NC3) dataset effort) but use of building energy codes funding for this type of effort (which should benefit numerous BT and DOE programs) is problematic at best.

4.2.7 Building Energy Codes Strategies for Overcoming Barriers/Challenges

From an overall DOE building energy codes perspective, the biggest barriers to building energy codes are associated with:

- Resistance to code adoption within states and local jurisdictions, and
- Low tolerance for code complexity on the part of code users (builders, contractors, code officials). This barrier results from two things: 1) a lack of technical sophistication (more a residential issue than commercial) and 2) a perception that efforts spent on energy code compliance have no or low returns in terms of recouped costs, increased marketability, or reduced liability.

For these reasons, a large portion of BT's effort is devoted to making the codes simpler and easier to understand and use, with the goals of overcoming resistance to "some complex code" and making the lack of technical sophistication less an issue. BT's efforts in developing support software (discussed under Technical Task Descriptions) were almost entirely focused on making the code easier to use and making it easier for code officials to enforce. BT's recent efforts in rewriting the residential portion of the ICC IECC were also focused largely on simplification and elimination of ambiguities.

4.2.8 Building Energy Codes Tasks

There are a large number of tasks associated with the voluntary commercial, voluntary residential, Federal commercial, Federal residential, and manufactured housing aspects of BT's Building Energy Codes subprogram. Rather than repeat the contents of the individual project management plans for the commercial R&D and residential R&D subprograms of DOE's overall codes efforts, a general summary of the tasks associated with these efforts will be provided. Specific details and funding levels will vary from year to year for each task.

Federal Sector Activities

Both the residential and commercial subprograms contain tasks supporting the ongoing development of Federal sector standards, as mandated by the Energy Policy Act of 1992. These tasks are focused on development of new Federal building rules. Deployment and training associated with these rules has historically been the responsibility of BT's Federal Energy Management Program (FEMP), rather than WIP.

Formal Determination Activities

Both the residential and commercial subprograms contain tasks to perform the analysis leading up to DOE's formal determination of energy savings for new versions of the ICC

IECC (residential) and ASHRAE Standard 90.1 (commercial), as mandated by the Energy Policy Act of 1992.

Support for EPAct-Designated Voluntary Sector Code Development
Both the residential and commercial subprograms contain tasks to support the development of EPAct-mandated voluntary sector standards (the ICC IECC for residential and ASHRAE Standard 90.1 for commercial). Commercial tasks may have multiple subtasks for support of the various subcommittees charged with developing these building energy codes or for addressing various aspects of these building energy codes (envelope, mechanical systems, lighting, etc). The primary tasks for residential codes tend to focus on the building envelope and mechanical systems, and the whole building tradeoff approach utilized in the IECC. During the course of working with these various subcommittees, the BT Building Energy Codes subprogram does come into contact with other code development participants who can and will supply the current practice, cost, and compliance data that can help address the barriers listed above.

Support for Alternative Voluntary Sector Code Development
Both the residential and commercial subprograms contain tasks to support the development of alternative voluntary sector codes that are commonly adopted or considered for adoption by the states or have the potential to be incorporated into the IECC. In the residential sector, the "alternative" building energy codes are the ICC IRC and ASHRAE Standard 90.2. In the commercial sector, the "alternative" code is the IECC, which is actually the most commonly adopted set of commercial requirements. These tasks are not explicitly mandated by EPAct, but do fall in the area of supporting state adoption of codes (another DOE mandate in EPAct) because many states do adopt the IECC and IRC.

Support for "Above Code" or "Beyond Code" Efforts
Both the residential and commercial subprograms contain tasks to support various above code or beyond code activities that may provide insights into future code enhancements. In the residential sector, the main above code efforts that this subprogram interacts with are BT's Building America and the Residential Energy Services Network (RESNET, which maintains the most commonly used specification for Home Energy Rating Systems). In addition to mining these better-than-code programs for potential new code provisions, these activities also assist the programs in eliminating code barriers to the use of new and innovative materials, equipment, and construction techniques.

In the commercial sector, the three main above/beyond code interactions include:

- ASHRAE's Special Project 102 Advanced Energy Design Guide: Small Office Buildings;
- The New Buildings Institute's (NBI) Benchmark; and
- The US Green Buildings Council's Leadership in Energy and Environmental Design (LEED) program.

ASHRAE's Advanced Energy Design Guide series is intended to complement ASHRAE Standard 90.1 by providing energy savings of 30% above Standard 90.1 for small office

buildings. ASHRAE will be developing 30% above code guides for additional building types that do not usually receive intensive design attention (small retail and roadside motels are on the list), and ASHRAE is also planning to take on guides that will achieve 50% and 70% savings above code.

NBI's Benchmark covers many common commercial building types and was originally targeted at 30% savings as well. Benchmark did achieve this level of savings for some, but not all building types. Benchmark is currently being used as the design guidance basis for EPA's Energy Star by Design program. DOE's role in the above code programs can be summarized as follows:

- Participation and leadership of development (ASHRAE SP 102)
- Promotion of above code material through code compliance software and online resource center (ASHRAE SP 102, NBI Benchmark, Building America)
- Use of above code material as basis of "codes of the future" (ASHRAE SP 102, NBI Benchmark, Building America)
- Participation in reformat of ASHRAE Standard 90.1 Energy Cost Budget method to assist in LEED usage

Working with groups on above and beyond code issues is another venue to obtain the current practice, cost, and code compliance data mentioned as barriers above.

Support for Addressing Barriers

As noted above, the barriers are not barriers in the traditional BT sense of the word and, therefore, the linkage between tasks and barriers is weaker than in other BT subprograms. However, the Building Energy Codes subprogram does attempt to provide funding to address these barriers if affordable opportunities present themselves. In FY05, the commercial portion of this subprogram is contemplating the development of a commercial construction current practice database, based on the NC3 database developed in this subprogram and the idea of open source software, where contributors to the database have free use of the contents in exchange for adding to and improving the contents. We hope to entice others to participate in the development of a larger database than any single participant could hope to develop on their own.

Table 4-8 Building Energy Codes Tasks

Task	Title
1	ASHRAE meetings
2	New versions of ASHRAE
3	ASHRAE Standard 90.1 determinations due
4	ICC proposals due
5	ICC code hearings
6	ICC code versions released
7	ICC code supplement released
8	ICC IECC determinations due
9	FEDRES
10	FEDCOM
11	ASHRAE SP 102 publication

4.2.9 Building Energy Codes Milestones & Decision Points

Milestones and schedules for BT's building energy codes efforts are driven largely by the schedules of the voluntary sector code processes that BT participates in. Both ASHRAE and ICC are now on 3-year cycles, with ASHRAE scheduled to deliver new versions of Standard 90.1 at the end of 2004, 2007, and so on. ICC's current cycle is scheduled to deliver new versions in 2006, 2009, and so on, essentially 2 years off of the ASHRAE cycle. ICC also issues a mid-cycle supplementary version of their code for those states interested in somewhat more current requirements. While ASHRAE accepts change proposals at any time under their continuous maintenance policy, the majority of activity with regards ASHRAE Standards is focused on their semi-annual meetings. ICC code change proposals are only accepted at certain times. For the 2006 IECC, proposed changes were due at the end of August 2004, approximately 16-18 months before the code itself is actually published.

These voluntary sector code efforts also drive BT's determination of energy savings activities (due 1 year after release of a new version of the baseline code or standard) and Federal standards activities (typically revised after major enhancements in the corresponding voluntary sector standard). Looking out over the next 6 years, the significant dates in Figure 4-1 can be noted. Significant milestones for Federal standards are not shown because of BT's lack of control over the actual release dates of these rulemakings.

The ASHRAE Standard 90.1 and ICC IECC Determination Milestones are the appropriate times for BT to determine if the building energy codes program is meeting its joule metrics because these will be the times that actual savings on Standard 90.1 (commercial) and the IECC (residential) are prepared. In a sense, these are go/no go points in that BT can determine to abandon or redouble efforts in building energy codes at these points based on the determinations.

The overall outcome for both residential and commercial codes is essentially a 6% to 11% increase in stringency in codes by the year 2010, continuing on to a 19% to 35%

increase in stringency in codes by the year 2025. As noted previously, increasing the stringency of the minimum mandatory requirements in building energy codes can only help make it easier for DOE to meet its ZEB goals.

Figure 4-1 Building Energy Codes Gantt Chart